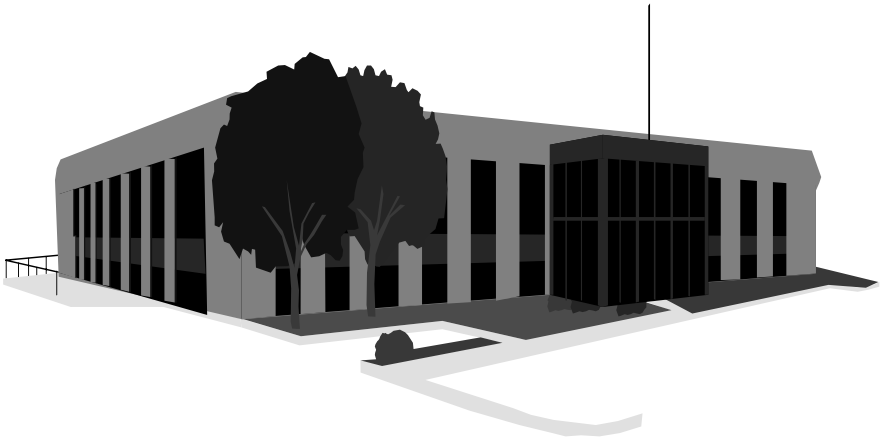
INDOOR AIR QUALITY ASSESSMENT

Swampscott High School
1 Forest Avenue
Swampscott, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
March, 2001

Background/Introduction

At the request of Peter Sack, Principal, an indoor quality assessment was conducted at the Swampscott High School in Swampscott, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). On November 14, 2000 the school was visited by Cory Holmes, Environmental Analyst, Emergency Response/Indoor Air Quality (ER/IAQ) program and Suzan Donahue, Research Assistant, ER/IAQ to conduct an indoor air assessment. This request was prompted by odor complaints attributed to the use of products (i.e., polyurethane, graffiti remover, paint thinners) containing respiratory irritants within the school.

The school consists of two wings: the original building and the addition. The original building is a two-story red brick building built as a junior high school in 1959. The school was renovated, including an addition, when the school was converted to a high school in 1977. The second floor of the original building contains general classrooms. A print shop, darkroom, art rooms, preschool classrooms and offices are located on the first floor. The basement of the original building contains woodshops, an auto shop, an electrical shop and drafting room. The addition contains general/science classrooms, cafeteria, and gymnasium.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Screening for total volatile

organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID).

Results

This school houses grades nine through 12 and has a student population of approximately 780 and a staff of approximately 90. The tests were taken under normal operating conditions. Test results appear in Tables 1-7.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 ppm (parts per million) in thirty-two of the fifty-four areas surveyed. This is indicative of a ventilation problem in these areas of the school. Fresh air in most classrooms is supplied by a unit ventilator (univent) system (see Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building (see Picture 2) and return air through an air intake located at the base of each unit. The mixture of fresh and return air is drawn through a filter and a heating coil, and is then expelled from the univent by motorized fans through fresh air diffusers (see Figure 1). Univents were found deactivated in a number of classrooms (see Tables). Obstructions to airflow, such as books, papers, and desks were seen in a number of classrooms (see Picture 3). In order for univents to provide fresh air as designed, they must be unblocked and remain free of obstructions. Importantly, these units must be activated and allowed to operate.

The mechanical exhaust ventilation system in each classroom consists of ducted, grated wall/ceiling vents; many of which were obstructed by furniture, storage carts, shelves

and other items (see Picture 4). Exhaust vents were functioning in most classrooms. Exhaust ventilation for science classrooms is provided by ceiling-mounted exhaust vents located in a chemical storeroom between science classrooms. Passive grills are mounted on the storeroom doors to draw classroom air into the storerooms and out of the building through the exhaust vents (see Pictures 5 & 6). The science classroom ventilation systems were also operating during the assessment, however classroom occupants complained of lingering odors after conducting science experiments. Carbon dioxide readings in the science area were above 800 ppm, which as discussed previously can indicate poor air circulation.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded.

When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature measurements ranged from 65^{o} F to 74^{o} F, which were below the BEHA recommended range for comfort in some areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. It is difficult to control temperature and maintain comfort without ventilation equipment operating as designed. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in this building was within the BEHA recommended comfort range in all areas sampled. Relative humidity measurements ranged from 40 to 52 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40-60 percent. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low

relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

A number of rooms had water-stained ceilings and ceiling tiles, which are evidence of roof and/or plumbing leaks (see Picture 7). Water-damaged ceiling tiles can provide a source of mold and mildew growth and should be replaced after a leak is discovered. Plants were noted in several classrooms. Plants can be a source of pollen and mold, which can be a respiratory irritant to some individuals. Plants should be properly maintained and be equipped with drip pans. Plants should also be located away from air diffusers to prevent aerosolization of dirt, pollen or mold. Along the outside perimeter of the school several fresh air intakes are partially obstructed with shrubbery (see Picture 2). Shrubbery can be a source of moisture and/or pollen, which can be pulled into air intakes (called entrainment) and subsequently distributed into the classroom.

Room 238 contained a jar of standing water with algae growth, located near the univent (see Picture 8). Standing water can lead to algae/mold/bacterial growth. These growths can be a source of foul odors and can be irritating to some individuals.

Spaces were noted between the splashboards and countertop of sinks. Improper drainage or overflow could lead to water penetration of countertop wood and potential damage to the cabinet as well as to stored materials. If wooden cabinets and porous materials become wet repeatedly they can provide a medium for mold and mildew growth. If this occurs the areas should be cleaned with an appropriate antimicrobial agent.

Other Concerns

A number of other conditions that can potentially affect indoor air quality were also identified. As discussed previously, complaints from occupants regarding the use of irritating materials prompted this request. At the time of the assessment the use of these materials had ceased. No lingering odors were noted by BEHA staff. Measurable levels of TVOCs were noted in two areas. Room 6 and the finishing room off the wood shop had TVOC levels of 0.4 and 1.0 ppm respectively. In both cases VOCs were off gassing from stored items (e.g., duplicating fluid, adhesives, solvents). These materials contain VOCs and can be a source of eye and respiratory irritation if not stored properly. No measurable levels of carbon monoxide were detected in the building.

A kiln was observed in the art room 102 (see Picture 9). The kiln was equipped with local exhaust ventilation and was operating during the assessment. Kiln exhaust may contain hazardous and irritating materials including sulfur dioxide and carbon monoxide. A working exhaust vent to the main school ventilation system was found in the art room close to the kiln's location. This vent can possibly compete with the local exhaust provided to entrain kiln odors/exhaust and introduce these pollutants to other sections of the school.

The print shop is located in a classroom with a univent and general exhaust vent. No dedicated local exhaust ventilation system exists for printers to remove ink odors (see Picture 10). Inks and other printing materials may contain petroleum hydrocarbons and/or VOCs, which evaporate after application. Without dedicated exhaust ventilation, VOCs can migrate from the print shop to adjacent areas. Material safety data sheets (MSDS') for the hazardous materials used in printing should be obtained and consulted in order to gauge the appropriate design of local exhaust ventilation necessary for printing presses. No print shop activities were being conducted at the time of the BEHA assessment.

The darkroom, adjacent to the print shop, has a local exhaust hood to draw odors away from users (see Picture 11). A switch on the wall activates the exhaust hood. The switch was "off" during the assessment, which means the exhaust system was deactivated. No photo developing activities were being conducted during the assessment. The hood was activated by BEHA staff. Darkrooms use a number of developing chemicals containing VOCs, which can create odors, and can be irritating to the eyes, nose and throat.

The science/shop areas were examined for evaluation of storage conditions of chemicals/flammables. A number of storage conditions in the building can influence indoor air quality in immediately adjacent classrooms or can be safety hazards. These include:

- Bases being stored in an acid storage cabinet along with acids (see Picture 12). Bases and acids should not be stored together.
- A number of materials appear to be of extreme age. A can of insecticide dated 1968 was stored in the flammables locker (see Picture 13).
- The finishing room of the woodshop contained a flammables locker that had unlabeled containers. As discussed previously, some containers were not sealed properly (see Picture 14) and were off gassing VOCs.

It is recommended that an ongoing, periodic inventory of chemicals in the science department be done to assess chemical storage and dispose of unwanted chemicals. Disposal of unwanted chemicals in a manner consistent with Massachusetts hazardous waste laws is recommended.

Yellowjackets were observed on/around a window of the choral room (see Picture 15). Yellowjackets are stinging insects and can cause allergic reactions in certain individuals. Other insect bodies were also seen on the windowsill. Insect parts can become dried out and aerosolized and may also serve as a source of allergenic material for sensitive

individuals. Under current Massachusetts law that will go into effect November 1, 2001, the principles of integrated pest management (IPM) must be used to remove pests in state buildings (Mass Act, 2000). A copy of the IPM guide is attached as Appendix A.

Several areas had open utility holes and/or missing/dislodged ceiling tiles (see Picture 16). Open utility holes can provide a means of egress for odors, fumes, dusts and vapors between rooms and floors. The missing/dislodged ceiling tiles can introduce dirt, dust and particulate matter into occupied areas of the school. These materials can be irritating to certain individuals.

Cigarette ashes were observed on a seat in the girl's restroom located outside the cafeteria. Environmental tobacco smoke can have a marked effect on indoor air quality. Environmental tobacco smoke is an indoor air pollutant, a respiratory irritant and can exacerbate the frequency and severity of symptoms in asthmatics. The most effective method of preventing exposure to environmental tobacco smoke is to have smoke free buildings. M.G.L. Chapter 270, Sec. 22 prohibits smoking in public buildings, except in an area which has been specifically designed as a smoking area (M.G.L., 1987).

A number of areas contained portable air conditioning units. These units are normally equipped with filters, which should be cleaned or changed as per the manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter.

Accumulated chalk dust was noted in several classrooms (see Picture 17). Chalk dust is a fine particulate, which can be easily aerosolized and is an eye and respiratory irritant. Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile

organic compounds (VOCs), such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Although no complaints of vehicle exhaust emissions were reported, the possibility of entrainment exists. Picture 18 illustrates the close proximity of the employee parking lot to the building and the potential for vehicle exhaust entrainment by univent fresh air intakes. Idling vehicles can result in the entrainment of vehicle exhaust into the building. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of five minutes (MGL, 1996).

Conclusions/Recommendations

The conditions found in the Swampscott High School present a series of problems that require a series of remedial steps. For this reason a two phase approach is recommended, consisting of immediate **(short-term)** measures to improve air quality and **long-term** measures that will require planning and resources to adequately address the overall indoor air quality concerns here. In view of the findings at the time of this assessment, the following **short-term** recommendations are made:

1. For any current or future applications of VOC containing products/compounds (e.g., polyurethane, graffiti remover, paint thinners) schedule projects, which produce large amounts of odors, dusts and/or emissions during weekends or evenings after the school day. Preferably the application of these types of materials on a Friday after school hours during a three-day weekend would maximize during time while minimizing the potential of exposure to building occupants.

2. Operate univents and exhaust vents while classrooms are occupied. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control. Check fresh air intakes for repair, an increase of the percentage of fresh air intake may be necessary. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers school-wide.
3. Consider having the ventilation system balanced by a ventilation engineer.
4. Remove all obstructions from supply and exhaust vents to facilitate airflow. Clear shrubbery from univent intakes on exterior of the school.
5. Replace filters as per the manufacturer's instructions for all univents and air handling equipment.
6. Repair and/or replace thermostats and pneumatic controls as necessary to maintain control of thermal comfort.
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
8. Repair any existing water leaks and replace any remaining water-stained ceiling tiles. Examine the areas above these tiles for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial as needed.

9. Ensure plants are equipped with drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary. Move plants away from air diffusers in classrooms.

10. Seal areas around sink in classrooms, to prevent water-damage to the interior of cabinets and adjacent wallboard. Inspect wallboard for water-damage and mold/mildew growth. Repair/replace as necessary. Disinfect areas of microbial growth with an appropriate antimicrobial as needed.

11. Remove jar of standing water from univent area in classroom 238.

12. Clean chalkboards and trays regularly to prevent the build-up of excessive chalk dust.

13. Clean/change filters in portable air conditioners as per the manufacturer's instructions to prevent the re-aerosolization of dirt, dust and particulate matter.

14. Store cleaning products and chemicals properly and keep out of reach of students.

15. Have a chemical inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials. Obtain Material Safety Data Sheets (MSDS') for chemicals from manufacturers or suppliers.

16. Store flammable materials in flameproof cabinets in a manner consistent with state and local fire codes.

17. Consider obtaining an acid resistant storage cabinet for the chemistry storeroom.

18. Maintain MSDS' and train individuals in the science department in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (M.G.L., 1983).

19. Replace damaged flexible ductwork for local exhaust in the wood shop.

20. Determine whether the ceiling vent in the chemical storeroom is functioning. Repair if not functioning. If the vent is part of the general exhaust ventilation system, seal this vent to prevent chemical odors from penetrating into occupied areas. Consideration should be given to installing a dedicated local exhaust vent for this area.

21. Prohibit smoking in this building in accordance with Massachusetts law M.G.L. Chapter 270, Sec. 22 (M.G.L., 1987).

22. Replace missing ceiling tiles and seal utility holes in ceilings and walls to prevent egress of odors, fumes and vapors.

23. It is highly recommended that the principles of integrated pest management (IPM) be used to rid this building of pests. As previously noted, a copy of the Massachusetts IPM recommendations is included with this report as Appendix A (MDFA, 1996).

24. Consider reconfiguring employee parking lot to avoid entrainment of vehicle exhaust. If this is not feasible, post signs in parking area instructing employees not to back in.

25. Consider installing a timer to activate the dark room exhaust system during school hours.

The following **long-term** recommendations should be considered:

1. Consider installing local exhaust ventilation in science rooms to supplement existing ventilation and to help remove chemical odors from lab experiments.

2. Relocate or consider installing local exhaust ventilation to draw chemical odors away from printing press operators. Consider consulting a certified industrial hygienist for appropriate ventilation in this area.
3. Consider relocating the kiln to a separate room and/or closer to the outside wall to aid mechanical exhaust and to avoid potential exposure to kiln emissions.

References

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

Mass. Act. 2000. An Act Protecting Children and families from Harmful Pesticides. 2000 Mass Acts c. 85 sec. 6E.

McCann, M. 1985. *Health Hazards Manual for Artists*. 3rd ed. Lyons & Burford, Publishers, New York, NY. Pp. 34.

MDFA. 1996. Integrated Pest Management Kit for Building Managers. Massachusetts Department of Food and Agriculture, Pesticide Bureau, Boston, MA.

MGL. 1983. Hazardous Substances Disclosure by Employers. Massachusetts General Laws. M.G.L. c. 111F.

MGL. 1996. Stopped motor vehicles; Operation of Engine; Time Limit; Penalty. Massachusetts General Laws. M.G.L. c. 90:16A.

MGL. 1987. Smoking in Public Place. Massachusetts General Laws. M.G.L. c. 270, sec. 22.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

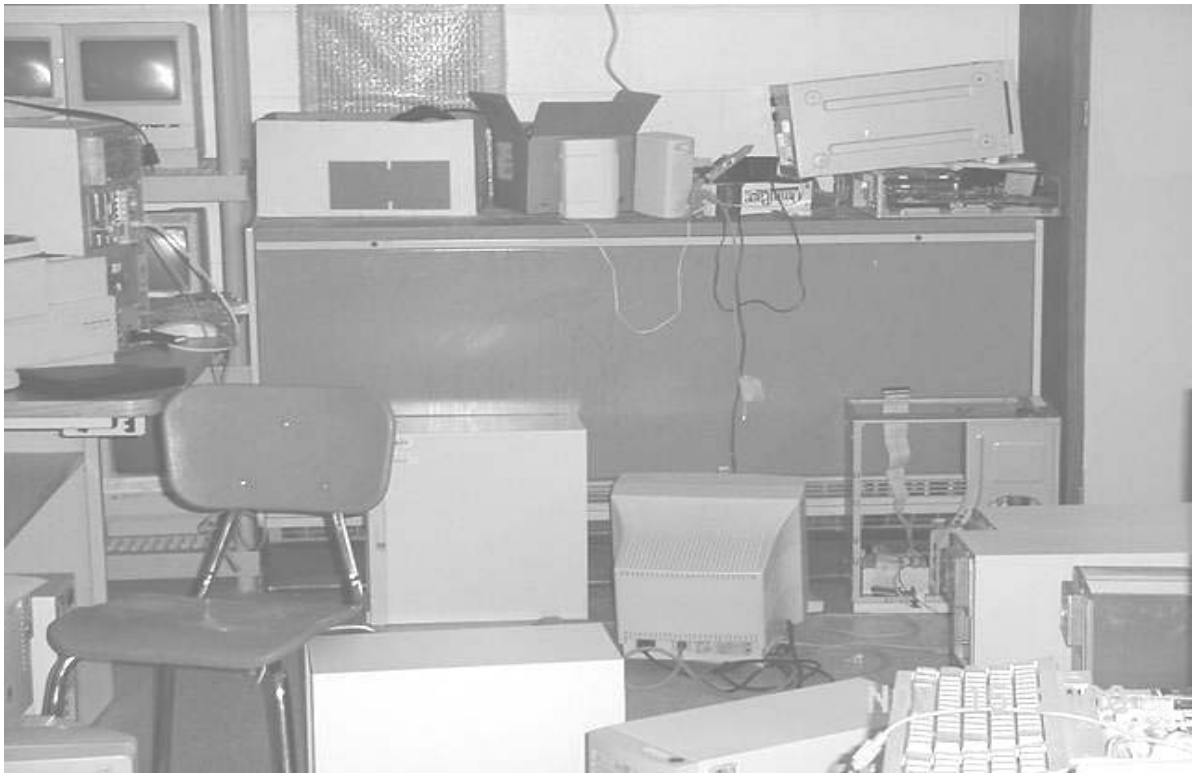
Picture 1

Classroom Univent

Picture 2

Univent Fresh Air Intake Obstructed by Plant Growth

Picture 3



Univent Obstructed by Various Items

Picture 4

Classroom Exhaust Vent

Picture 5

Passive Vent on Chemical Storeroom Door Providing Exhaust Ventilation for Science Classroom

Picture 6

Ceiling Mounted Exhaust Vent for Science Classroom Located in Chemical Storeroom

Picture 7

Water Damaged Ceiling Tiles

Picture 8

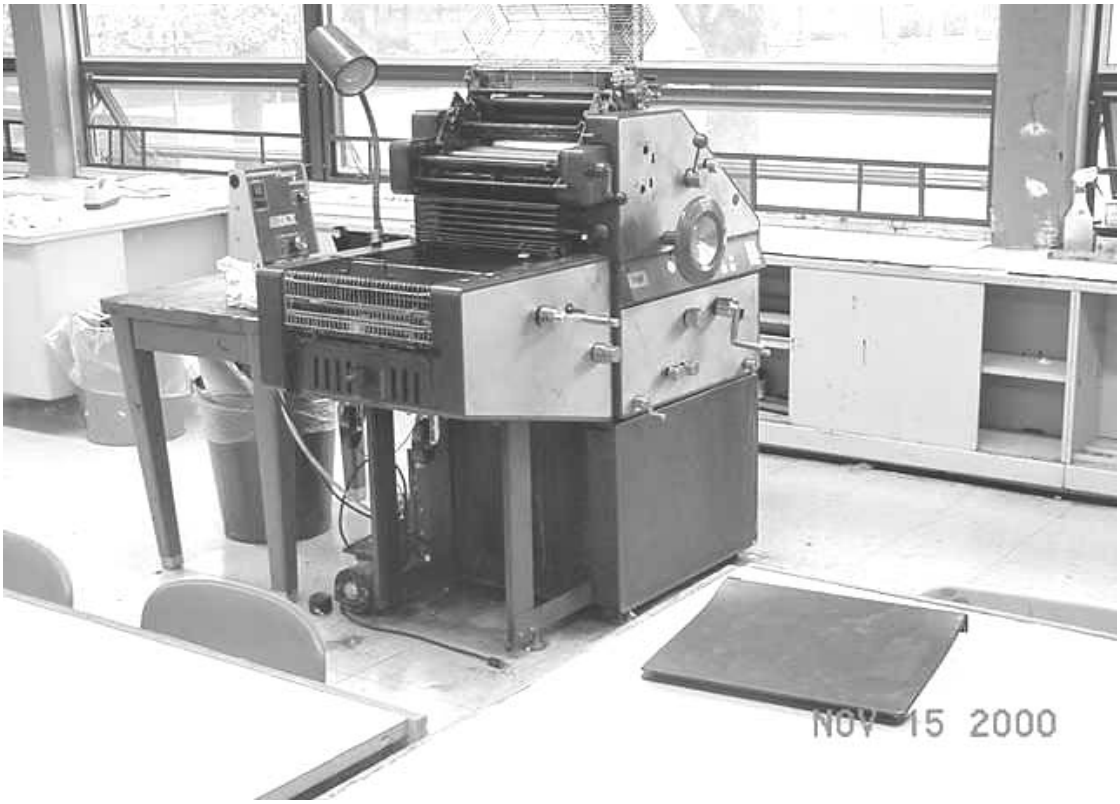
Algae Growth in Standing Water near Univent in Classroom 238

Picture 9

General Exhaust Vent

Kiln in Art Room 102

Picture 10



Printing Press in Print Shop/Classroom

Picture 11

Local Exhaust Vent Located in Dark Room

Picture 12

Acids and Bases Stored on Together

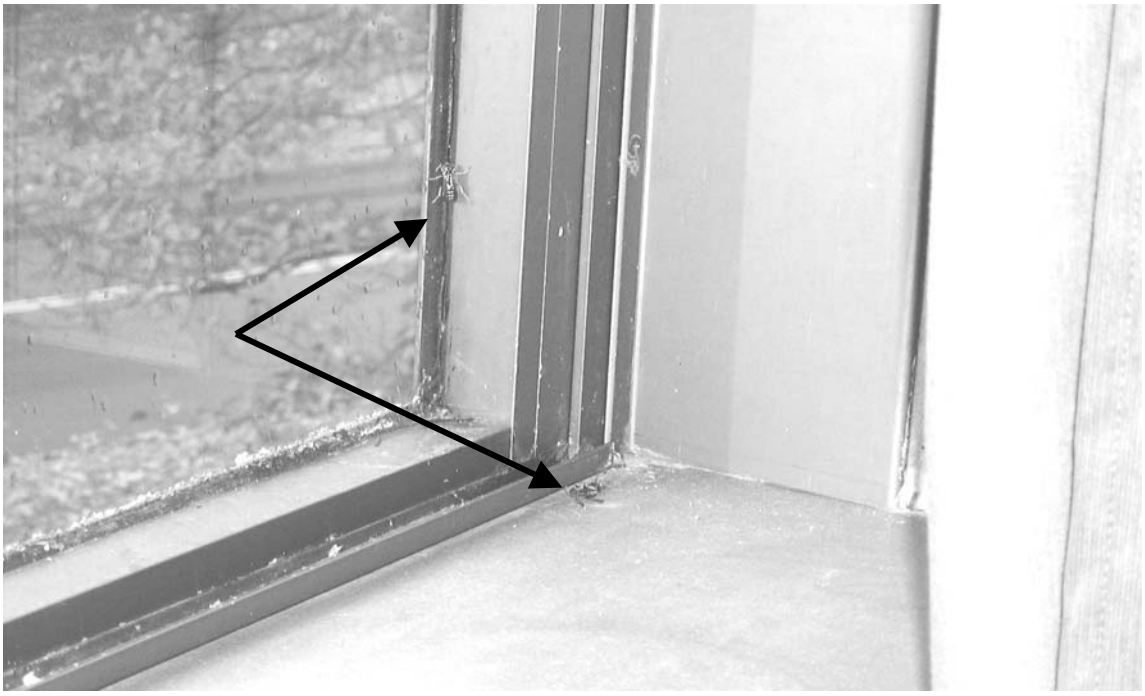
Picture 13

Chemical Storage Note Pesticide Spray Can

Picture 14

Contents of Woodshop Storage Cabinet
Note Unlabeled and Improperly Sealed Containers

Picture 15



Yellow Jackets on Window in Choral Room

Picture 16

Broken Ceiling Tile

Picture 17

Accumulated Chalk Dust in Classroom

Picture 18

Proximity of Univent Fresh Air Intake to Employee Parking Lot

TABLE 1

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	423	54	59					Weather conditions: overcast, rain in afternoon
Main Office-Reception	791	72	44	7	Yes	Yes (2)		Plant, 2 a/c mounted over windows, carpet, 3 water damaged CT, 2 CT ajar, door open
Room 6	724	68	44	1	Yes	Yes		Supply off, window and door open, 8 water damaged CT, 2 missing CT, accumulated items, duplicating fluid, spray adhesive, solvents, water damage above exterior door, TVOCs= 0.4
Auto Shop	579	68	45	0	No	Yes	Yes	Water damaged ceiling plaster, garage door-slightly open, exterior door, CO = 0.0, TVOCs=0.0
Wood Shop	538	68	45	0	No	Yes	Yes	Exterior door, TVOC=0.0
Wood Shop	909	71	48	14	Yes	Yes	Yes	Supply turned off-heat complaints, 4 water damaged CT, broken CT, wall cracks/utility holes, spaces around exterior door, lathe, CO=1
Seminar Room	864	73	41	0	No	Yes	Yes	Utility holes, broken CT

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Electronics Room	547	72	40	0	Yes	Yes	Yes	7 water damaged CT, water damage
Cafeteria (upper)	1582	74	44	5	No	Yes		200+ occupants gone <5 min., vending machines, utility holes, missing CT
Cafeteria (lower)	1525	72	44	0	Yes	Yes (3)	Yes	200+ occupants gone <5 min., window open
Staff Dining	868	73	43	1	Yes	Yes (2)	Yes	
Ladies Restroom (Outside Cafeteria)							Yes	Tobacco smoke odor-ashes around toilet, floor drain
Girl's Locker Room	624	70	44	0	No	Yes	Yes	Floor drain
Weight Room	980	71	45	1	No	Yes	Yes	
Gym	652	70	43	2	No	Yes	Yes	
Science Room 231	1122	72	47	22	No	Yes	Yes	Dry erase board
Room 232	1076	72	45	17	No	Yes	Yes	Dry erase board

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 234	1494	74	47	25	No	Yes		Univent partially blocked, exhaust hood, chemical storage, utility holes
Room 228	762	70	43	17	Yes	Yes	Yes	Dry erase board,
Room 225	1146	73	45	21	Yes	Yes	Yes	Univent off-debris, ajar CT, chalk dust
Room 220	1310	73	45	7	No			
Room 224	1262	72	44	21	Yes	Yes	Yes	~12 water damaged CT, 2 personal fans, chalk dust
Choral Room	1260	71	45	38	Yes	Yes	Yes	Univent blocked by clothes rack/bags, wall cracks, broken window, 2 plants, insects (yellow jackets) on window sill
Room216	1115	73	44	20	Yes	Yes	Yes	Univent blocked by cabinet, 26 computers, 4 water damaged CT, chalk dust
Teachers' Room	740	73	42	1	Yes	No	Yes	Window open, exhaust off, missing CT, utility holes
Room 212	1050	71	43	23	Yes	Yes	Yes	Window open, chalk dust

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 4

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 204	1220	72	45	20	Yes	Yes	Yes	Window open, dry erase board, 1 water damaged CT
Room 210	1207	74	45	14	Yes	Yes	Yes	Dry erase board
Room 208	1235	73	44	16	Yes	Yes	Yes	Chalk dust
Room 206	904	71	43	13	Yes	Yes	Yes	Window open, missing CT, dry erase board
Room 202	737	71	43	3	Yes	Yes	Yes	Chalk dust
Room 101 (Art Room)	731	73	43	8	Yes	Yes	Yes	Univent off, exhaust blocked, 2 missing CT, 30+ water damaged CT, missing floor tile, water damaged plaster, spaces around sink, utility holes
Room 102 (Art Room)	853	73	43	14	Yes	Yes	Yes	Univent blocked, exhaust off, missing CT, ~50 water damaged CT, kiln-vented, CO=0.0
Pupil/Personnel Services	707	73	42	1	Yes	No		Plant, photocopier, a/c unit over window, ~20 water damaged CT
Business Office	843	73	43	2	Yes	Yes	Yes	Univent blocked by cabinets, carpet, a/c over window,

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 5

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								photocopier
Guidance Office-Entry	664	73	41	0	No	Yes	Yes	
Reardon Office	1382	74	42	1	Yes	No	No	Window open
Pressler Office	1001	74	42	1	Yes	No	No	~10 water damaged CT
Finishing Room				0	No	Yes	Yes	Staining/furniture drying, exhaust weak/off, flammables locker-some containers not sealed, unlabled containers, TVOCs in cabinet=1.0
Crawlspace								Space under doors
Room 238	1072	70	52	19	Yes	Yes	Yes	Chalk dust, standing water in jar over univent, passive exhaust into prep room, odor complaints during dissection
Prep Room				0	No	No	Yes	5 water damaged CT, acids/bases on same shelf in acid storage cabinet, insecticide in flammables locker (1968), carbon tet

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 6

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 236	665	68	48	0	Yes	Yes	Yes	Passive exhaust into prep room, window open, dry erase board
Room 229	772	70	43	7	Yes	Yes	Yes	Door open
Room 226	950	72	46	7	Yes	Yes	Yes	
Room 221	969	72	45	8	Yes	Yes	Yes	Window open
Choral Room	1055	71	45	~40	Yes	Yes	Yes	
Room 219	730	72	45	0	No	Yes	Yes	Wall mounted a/c, univent covered with computer ports
Room 217	820	74	44	17	No	Yes	Yes	Wall mounted a/c
Room 215	710	73	43	0	No	Yes	Yes	Missing CT
Boys' Restroom				0	Yes	No	Yes	Window open
Room 211	980	69	46	15	Yes	Yes	Yes	
Room 209	1086	74	48	22	Yes	Yes	Yes	Window open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 7

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 203	731	72	44	18	Yes	Yes	Yes	Window open
Room 207	1271	72	46	20	Yes	Yes	Yes	Chalk dust
Room 201	1300	72	47	16	Yes	Yes	Yes	Folders on univent, univent off, dry erase board
Room 205	605	71	43	1	Yes	Yes	Yes	15 occupants gone ~45 min., 1 missing CT, dry erase board
Room 104 Print Shop	471	65	50	0	Yes	Yes	Yes	Window open, printing press-no local exhaust, no added ventilation, inks containing petroleum hydrocarbons
Dark Room				0	No	Yes	Yes	
Room 105	487	66	50	0	Yes	Yes	Yes	Univent buzzing, 20+ water damaged CT, 6 missing CT, window open, chalk dust
Room 106	517	70	50	2	Yes	Yes	Yes	14 occupants gone ~20 min., window open, dust on carpet, 7 missing CT, univent return blocked by couch/bookcase, missing CT in restroom

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 8

Indoor Air Test Results – Swampscott High School, Swampscott, MA – November 14, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
**212	940	71	26	26	Yes	Yes	Yes	Door open, CO=0
213	1097	73	27	25	Yes	Yes	Yes	
214	1370	73	28	21	Yes	Yes	Yes	CO=0
106-Principal's Office	814	71	24	1	Yes	Yes	Yes	CO=0
Main Office Area	859	73	23	3	No	Yes	Yes	Photocopier, CO=0
109	801	73	23	1	Yes	Yes	Yes	Personal fan, door open, CO=0
112	779	73	23	2	No	Yes	Yes	
108	737	73	23	0	No	Yes	Yes	Door open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%